Harry Freeman

hfreeman@andrew.cmu.edu | 650-830-2594 | harrynvfreeman.com

EDUCATION

Carnegie Mellon University, **School of Computer Science**, Pittsburgh, PA   Current
PhD in Robotics   GPA: 4.23

Carnegie Mellon University, **School of Computer Science**, Pittsburgh, PA   Awarded August 2023
Master of Science in Robotics   GPA: 4.23

Cornell University, **College of Engineering**, Ithaca, NY   Awarded May 2017
Bachelor of Science in Electrical and Computer Engineering   GPA: 3.73

RESEARCH EXPERIENCE

Kantor Lab - Carnegie Mellon University Robotics Institute, Pittsburgh, PA   August 2021 – Present
Research in Computer Vision, 3D Reconstruction, and Learning from Demonstration for Robotic Manipulation.
- Currently researching cross-embodiment learning from human demonstration by utilizing gaussian splatting and foundation models to render hand-eye views and train diffusion policies for robotic manipulation. Paper will be submitted to RSS in 2026.
- Developed a transformer-based method for temporal association of fruits and plant components from encoded 3D point clouds, demonstrating robustness utilizing different sensor modalities. Paper accepted to IROS 2025.
- Developed a next-best-view planner and robust estimation and graph clustering approach to size small fruit in agriculture. Implemented system on a 7-DoF robotic arm in the field. Paper accepted to ICRA 2024.
- Created a method to build high-quality 3D reconstructions of sorghum panicles using pose graph optimization and seed landmarks, enabling seed count extraction through coarse-to-fine clustering. Paper accepted to ICRA 2023.

AirLab - Carnegie Mellon University, Pittsburgh, PA   August 2020 – July 2021
Research in multi-drone collaboration for 3D human reconstruction
- Contributed to the 3D reconstruction pipeline for research on 3D human reconstruction for collaborative aerial cameras. Utilized deep pose estimation networks and multi-view reconstruction algorithms on real and simulated data. Paper accepted to IROS 2021.

PROFESIONAL EXPERIENCE

Amazon Robotics, Boston, MA   May 2025 – August 2025
Applied Science Intern
- Researched machine learning–based clustering methods to improve multimodal multiple extended object tracking.
- Designed a transformer-based clustering approach for multimodal inputs, building the entire system from scratch and establishing evaluation metrics and tests.
- Achieved 99% AMI, ARI, and ACC metrics on simulated datasets, demonstrating high accuracy and robustness with 5% improvement over current systems in place.
- Demonstrated qualitative success on real-world experimental data, validating practical applicability.
- Approach will be recommended to be implemented in production by project supervisor.

Advanced Optronics, Pittsburgh, PA   June 2024 – August 2024
Machine Learning Intern - Advised by Professor Wenzhen Yuan
- Experimented with different machine learning models to 3D reconstruct cochlear implant device shape and predict surgical complications from sequential readings of strain sensors using simulated data.
- Designed experiments, tests, and error metrics to evaluate the performance of the model with different levels of noise.
- Created a method to augment the dataset of 3D cochlea models using statistical shape models, deformable registration, and several 3D processing techniques.
- Improved method to simulate strain sensors using barycentric coordinates of tetrahedral meshes. Strain readings fell within 1% error of expected values with high-resolution meshes and 2% for low-resolution meshes used in simulation.
- Designed a learning-based method to optimize sensor placement on the device by backpropagating error through sensor locations.

Amazon AWS AI Devices, Palo Alto, CA   August 2020 – August 2021
Senior Software Development Engineer
- Senior embedded software engineer for AWS Panorama – a machine learning appliance that allows IP cameras to run computer vision and deep learning applications at the edge.
- Developed multi-threaded and multi-process application-level software that ran on the device. Supported the full application lifecycle from OTA to deployment to inference which allowed customers to run custom applications.
- Led the design and development of the entitlement and encryption service, a service which utilizes MQTT to communicate with the cloud and securely manages the IP of 1P and 3P applications.
- Contributed to the development of the data source service to allow customers to stream data from RTSP cameras and video files in real time.

Eversight, Palo Alto, CA   July 2019 – August 2020
Software Engineer
- Improved price recommendation system speed by 80% by re-designing backend container-driven system architecture using Kubernetes and Google Cloud Platform. The system could effectively scale and process resource-heavy tasks, including processing millions of transaction records daily and optimizing in-store prices using customer data.
- Led the architecture design that loaded customer data into our system using a scalable event driven architecture and Apache Beam, reducing the time of the overall process by 50%.

Edelman Financial Engines, Sunnyvale, CA   April 2018 – July 2019
Senior Software Engineer
- Developed an online financial planning tool to provide a new medium for financial advisors to offer financial advice.
- Led the design of a microservice to automate the migration of customer data from a competitor's platform to ours.
- Led the design of a report generation service to aggregate customer information and present likelihood of retirement goal success.

Macdonald, Dettwiler, and Associates, Vancouver, BC   August 2017 – March 2018
Embedded Software Engineer
- Acted as part of a small research and development team whose goal was to determine the feasibility and performance of implementing SAR image processing algorithms on FPGAs for real-time sea vessel detection and classification.
- Improved classification and detection speed by three orders of magnitude by successfully constructing embedded RTL designs in C and VHDL to implement SAR signal processing algorithms.
- Evaluated performance of system with regard to memory, time, and quantization constraints.

PUBLICATIONS
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Peer-Reviewed Conferences

- **Transformer-Based Spatio-Temporal Association of Apple Fruitlets**
  Harry Freeman, George Kantor
  Accepted to *IEEE International Conference on Intelligent Robots and Systems (IROS), 2025*
  [PDF][Project Page][Video]

- **Autonomous Apple Fruitlet Sizing with Next Best View Planning**
  Harry Freeman, George Kantor
  IEEE International Conference on Robotics and Automation (ICRA), 2024
  [PDF][Video]

- **3D Reconstruction-Based Seed Counting of Sorghum Panicles for Agricultural Inspection**
  Harry Freeman, Eric Schneider, Chung Hee Kim, Moonyoung Lee, George Kantor
  IEEE International Conference on Robotics and Automation (ICRA), 2023
  [PDF][Video]

- **3D Human Reconstruction in the Wild with Collaborative Aerial Cameras**
  Cherie Ho, Andrew Jong, **Harry Freeman**, Rohan Rao, Rogerio Bonatti, Sebastian Scherer
  International Conference on Intelligent Robots and Systems (IROS), 2021
  [PDF][Video]

Workshops

- **Towards Autonomous Apple Fruitlet Sizing with Next Best View Planning**
  Harry Freeman, George Kantor
  AI for Agriculture and Food Systems (AIAFS), 2023
  [PDF]

- **Toward Semantic Scene Understanding for Fine-Grained 3D Modeling of Plants**
  Mohamad Qadri, **Harry Freeman**, Franz Eric Schneider, George Kantor
  AI for Agriculture and Food Systems (AIAFS), 2022
  [PDF][Video]

Master's Thesis

- **Computer Vision-Based Phenotyping in Agriculture: Leveraging Semantic Information for Non-Destructive Small Crop Analysis**
  Harry Freeman
  Master's Thesis, 2023
  [PDF]

SKILLS

Programming Languages	Python, C++, C, Matlab, Java
Frameworks and Tools	Pytorch, Docker, OpenCV, Scipy
Cloud Platforms	AWS, GCP, Kubernetes
Computer Vision	Gaussian Splatting, NeRF, 3D Reconstruction
Robot Learning	Imitation Learning, Vision Foundation Models
Robotics Software	ROS, Gazebo, PyBullet, MoveIt, AirSim
Reinforcement Learning	Isaac Gym, skrl, Stable-Baselines3, OpenAI gym, imitation

RELEVANT GRADUATE COURSEWORK

Deep Learning for Robotics	Learning for 3D Vision	Computer Vision
Introduction to Robot Learning	Learning-based Image Synthesis	Graduate Artificial Intelligence

TALKS AND PRESENTATIONS

- IROS 2025 Oral and Poster Presentation (Remote), Hangzhou, China — October 2025
- ICRA 2024 Oral and Poster Presentation, London, England — May 2024
- Master's Thesis — August 2023
- AIAFS 2023 Oral and Poster Presentation, Washington DC, USA — February 2023

SERVICE

- CMU Master of Science in Robotics Admissions Committee (2025 admission cycle)
- CMU Graduate Application Support Program Mentor
- CMU RoboBuddies Mentoring Program

TEACHING EXPERIENCE

- Teaching Assistant, 16-385 Undergraduate Computer Vision — August 2024 – Present
- Teaching Assistant, 16-720 Graduate Computer Vision — January 2024 – May 2024

Reviewer for International Conference on Robotics and Automation (ICRA), International Conference on Intelligent Robots and Systems (IROS), Robotics and Automation Letter (RA-L)

OTHER PROJECTS

Graduate

- Investigated deep reinforcement learning methods to learn a unified policy that controls a quadruped mounted with a camera on a mobile arm with the task of tracking a moving target. The hypothesis is that this configuration enables the robot to explore more complex terrains when compared to using a fixed egocentric camera. Agent is trained using PPO in an Isaac Gym simulated environment.
[Project Writeup] [Code Repo]

- Applied deep reinforcement learning techniques towards informative path planning for drone mapping. Agent learns an optimal policy to intelligently explore an unknown map and visit areas of high interest. Experimented with both on-policy and off-policy approaches in addition to model-based and model-free algorithms.
[Project Writeup] [Code Repo]

- Utilized NeuS to create accurate, watertight meshes of plants from sparse 2D images. Models were made generalizable by incorporating Reptil meta-learning into training. Results demonstrate that meta-learning improves reconstructions with fewer training iterations, and our approach is able to generate realistic meshes and novel view syntheses with sparser 2D images compared to naïve approaches.
[Project Writeup] [Data Repo] [Code Repo]

- Utilized Generative-Adversarial Networks for coarse style and scene data augmentation. Method was based off Swapping AutoEncoders. Results successfully demonstrated that swapping latent style codes is effective approach for data augmentation to allow models to better generalize and not overfit the training data.
[Project Webpage] [Code Repo]

Personal

- Built a real-time face detection system in Cython and C using a variation of Histogram of Oriented Gradients. SVM was trained using LFW dataset, and overlapping bounding boxes are reduced using non-maximum suppression.
[Project Webpage] [GitHub Repo]

OTHER ACTIVITIES

Cornell Varsity Squash Team   August 2013 – May 2017
- Competed on the Cornell Varsity Squash Team.
- Captained the team my Senior year. Led and managed the team alongside the coach.
- Played at the number one position Junior and Senior years.
- CSA Scholar Athlete Junior and Senior years.
- Three-time recipient of team sportsmanship award.
- Two-time recipient of team most improved award.